INTRODUCTION

Angle closure glaucoma (ACG) is one of the leading causes of global blindness.\(^1\) In population-based research in Asia, close to 2% of individuals over the age of 40 exhibited ACG.\(^2,3\) Several studies have found that 15% to 45% of all ACG is acute (AACG),\(^1-3\) affecting millions of people worldwide. Although Asian populations may have a higher incidence of AACG than Western countries, the disease is not rare in the US. In 2004 alone, more than 82,000 Medicare claims were made for laser iridotomy.\(^4\) Almost every ophthalmology practice should see AACG at some time. In a typical year we experience three to five presentations.

ACUTE ANGLE CLOSURE GLAUCOMA

Clinically, AACG is the sudden increase in intraocular pressure (IOP) caused by acute obstruction of aqueous drainage by the iris. Symptoms include diminished visual acuity, colored halos around lights, nausea, and severe pain. Examination typically reveals a poorly reacting, mid-dilated pupil, shallow anterior chamber with a bowing of the iris. Microcystic edema of the corneal epithelium is commonly found during an acute attack. Without urgent treatment, AACG can lead to severe and permanent damage to the eye.\(^5\)

LASER PERIPHERAL IRIDOTOMY – THE STANDARD OF CARE

Laser peripheral iridotomy (PI) using either an argon or neodymium:YAG laser has replaced surgical iridectomy as the standard of care for AACG.\(^6\) The advantages largely revolve around safety. Laser PI does not require general anesthesia and has a lower risk for complications such as infection and suprachoroidal hemorrhage. Although PI is generally considered a safe procedure, laser energy delivered at the time of treatment may result in complications such as more rapid development of cataract or development of posterior synechiae.\(^7,8\) Argon laser PI,

ABSTRACT: Angle closure glaucoma is one of the leading causes of blindness worldwide. The typical treatment for acute cases is laser peripheral iridotomy, but corneal clouding and edema can often impair the ability to create a successful iridotomy with a standard multi-mode YAG laser. This paper presents the results of two cases in which the VISULAS YAG II\textsuperscript{tm} laser from Carl Zeiss Meditec was used to successfully complete a laser peripheral iridotomy after other lasers had failed. The VISULAS laser, with its reported “Super-Gaussian” beam, appears to deliver more useful energy to the target with less diffusion to surrounding tissue. More power is available to break acute attacks but with lower total energy to the eye. Our experience has taught us that the initial energy settings recommended by standard reference sources should be dramatically reduced when changing to the VISULAS. At our center, the VISULAS has been a proven performer in the treatment of angle closure glaucoma.
specifically, has been consistently reported to cause localized transient corneal edema, with rare case reports of corneal decompensation.10

**Limitations of Laser PI**

Unfortunately, laser PI is not always successful. One reason it fails is the presence of microcystic edema that clouds the cornea and dissipates the laser energy. The result is high levels of energy absorbed by eye without achieving a successful iridotomy. The consequences of failed PI can be severe: delay in pain relief, permanent damage to the eye and vision, and invasive surgery.

**Not All Lasers Are Created Equally**

When we first started performing laser PI at the Shepherd Eye Center, we expected commercially available lasers would all have roughly equal levels of performance. We assumed that YAG lasers from different manufacturers would have the same abilities. We were wrong.

We perform between three hundred and four hundred iridotomies a year, so we need the best tools we can find. During a product review, we performed a side-by-side comparison of our YAG laser with the VISULAS YAG IIplus laser from Carl Zeiss Meditec. We performed laser PI in a series of approximately ten patients using our laser on one eye and the VISULAS on the other. The results simply amazed us. The comparison wasn’t even close. The VISULAS achieved patent iridotomies with only a fraction of the number of shots and total energy delivered as our old laser.

Just as importantly, the VISULAS performed at an entirely different level of precision. With the VISULAS we saw significantly less bleeding during surgery because we could more easily avoid blood vessels. The edge of the beam was so well defined, we could ablate individual fibers. Without reservation, we shelved our old laser and started using the VISULAS exclusively.

As we gained experience with the VISULAS, our old laser seemed more like a blunt instrument compared to the surgical precision we were now achieving. We were happy to provide a higher level of performance to our patients so that their iridotomy was created with less trauma and total applied energy. Only later did we learn that with the VISULAS we could also effectively retreat patients who had previously failed PI with other lasers. Here we present the results of two such cases.

**CASE PRESENTATION-PATIENT 1**

Patient 1 was a 54-year-old woman with acute ACG referred to our center for surgical iridectomy due to reported failed YAG laser iridotomy by the referring physician. She presented with IOP above 40 mmHg in the affected eye and a cloudy cornea exhibiting microcystic edema. She was in the third day of the attack, and microscopic examination showed scarring of her iris tissue consistent with the reported attempt at laser PI. Before considering surgical iridectomy, we recommended another attempt at laser PI using the ZEISS VISULAS YAG IIplus laser. The patient agreed and received three bursts of 2.4 mJ energy to the iris. The iridotomy was successful with immediate deepening and a reduction in IOP. The acute attack had been broken. Unfortunately, this eye developed cataract and residual glaucoma and eventually required combined cataract and trabeculectomy surgery. We wonder if the attack could have been broken sooner if the eye might have avoided the additional surgery.

**CASE PRESENTATION-PATIENT 2**

Patient 2 was a 68-year-old man with acute ACG referred to our center for surgical iridectomy. He presented to us on the first day of his attack with an IOP above 60 mmHg in the affected eye accompanied by diffuse microcystic edema. The referring physician reported two attempts at laser PI without success due to the edema. We recommended an additional
iridotomy attempt using the VISULAS laser, but the patient declined because of the possible pain and his experience with the failures of the first two attempts. After a discussion of the benefits and possible risks of iridotomy versus the more invasive surgical approach, the patient agreed to one last attempt. With a single burst of 4.5 mJ energy from the VISULAS laser, we were able to break the attack, lower the IOP to 12 mmHg during the first day, and achieve a complete resolution without apparent permanent damage.

**CASE DISCUSSION**

Resolution of AACG is an urgent issue. We must break the attack as quickly as possible to reduce the pressure and prevent permanent damage to the cornea, lens, and optic nerve. We were able to rescue Patient 2’s vision because of the relatively short amount of time between the initial diagnosis and effective treatment. We were not so fortunate with the first patient. We speculate if she had access to a VISULAS laser sooner, her experience and outcome may have been better. Our experience with Patient 2 also highlights another important feature of early, effective treatment. After two failed iridotomies, Patient 2 experienced enough pain that he was reluctant to accept another attempt. The advantage of a more precise and powerful laser is obvious.

Our clinical experience with the VISULAS YAG laser has shown us that ophthalmic lasers differ significantly in terms of performance and precision. I am not a physicist and do not completely understand all the details of what makes this laser different. Carl Zeiss Meditec claims that the VISULAS has a more focused beam made possible by their “Super-Gaussian” technology. They claim the typical YAG has a multi-mode beam with a diffuse breakdown pattern, but the VISULAS has a sharp drop-off in energy away from the focus (Figs. 1,2). The result is that the VISULAS beam has a sharper, more defined edge so that cutting power is achieved with less total beam energy. This enables the VISULAS to function even through a clouded cornea without applying unacceptably high levels of total energy to the eye. Whether or not this explanation is the whole story, our clinical results confirm that the ZEISS VISULAS YAG laser delivers more useful energy at the target, and we can now effectively treat even the toughest cases that were beyond our reach when we were using older YAG laser technology.

**CLINICAL IMPLICATIONS**

Our clinical experience with laser PI in general, and these two cases in particular, indicate two things:

- The VISULAS YAG laser is proven performer for treatment of AACG.
- When using the VISULAS laser, published energy values for PI are much too high.

The recommended initial energy settings from several standard references are shown in Table 1. They range from 2 mJ up to 15 mJ. When changing to the VISULAS, we recommend dividing your old initial setting by a factor of four. Our typical initial settings are shown in Table 2.

**CONCLUSION**

In our hands, the ZEISS VISULAS YAG IIplus laser successfully performed iridotomy after other lasers had failed. Because the consequences of failed iridotomy are so severe – permanent damage to the eye and vision as well as additional surgery – we recommend that you test the VISULAS against your current laser in your practice. See for yourself whether this tool can help you achieve better outcomes in your patients with ACG.
Table 1: Recommended Initial Settings from Standard References

<table>
<thead>
<tr>
<th>Source</th>
<th>Initial Setting for Peripheral Iridotomy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shields Textbook of Glaucoma, 5th Edition\textsuperscript{11}</td>
<td>5 to 15 mJ</td>
</tr>
<tr>
<td>Chandler and Grant’s Glaucoma, 4th Edition\textsuperscript{12}</td>
<td>5 to 7 mJ</td>
</tr>
<tr>
<td>AAO Clinical Science Course, Glaucoma 2004-2005\textsuperscript{13}</td>
<td>2 to 8 mJ</td>
</tr>
<tr>
<td>Glaucoma Today, Surgical Pearls, Vol 4, No. 5\textsuperscript{14}</td>
<td>8 to 10 mJ</td>
</tr>
</tbody>
</table>

Table 2: Shepherd Eye Center Typical Initial Settings for VISULAS YAG Laser

<table>
<thead>
<tr>
<th>Source</th>
<th>Initial Setting for Peripheral Iridotomy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iridotomy</td>
<td>1.8 to 2.4 mJ (max 4.5 mJ)</td>
</tr>
<tr>
<td>Capsulotomy</td>
<td>0.8 to 1.8 mJ</td>
</tr>
<tr>
<td>Iris synechialysis</td>
<td>1.8 mJ (anterior focus)</td>
</tr>
<tr>
<td>Strand vitreolysis</td>
<td>0.8 mJ</td>
</tr>
</tbody>
</table>

**Figure 1.** Difference in profile between ZEISS Super-Gaussian Beam and typical multi-mode YAG laser.

**Figure 2.** Optical breakdown difference between ZEISS Super-Gaussian Beam, a fundamental mode laser, and a typical multi-mode YAG laser.
REFERENCES


